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ABSTRACT

The psychological concept of consciousness is examined in this article. It is argued that the intentionality of an individual's behavior is the key to the measurement and representation of his consciousness. The experiment examined concerns groups of students of business administration and civil engineering as well as professional economists, and their responses to models of future society. Topological structures are formulated based on the groups' responses in terms of various aspects of consciousness as it is here defined. Distinctive aspects characterize the groups such that they can be ordered on a scale from non-consciousness to consciousness. Increasing consciousness implies increasing conceptual autonomy in tne respective group's cooperation with its environment, and consequently, also an increase in its chance to survive in competition. A 31-item list of references is included. (DB)

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The Topological Scaling of Consciousness
The World in the Perspective of Economists and Technologists

Bernhard Bierschenk

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Abstract

The article presents an analysis in which intentionality is the key concept in the measurement and representation of consciousness. It is shown that a psychological approach based on the animal mechanism out of which behavioural semantics has developed is wrong. By studying the local and global singularities it was possible to show that efficient transaction with the environment rests on the theoretical formulations that assume the cooperative interaction of a conscious organism with the environment. Moreover, consciousness cannot be specified as the outcome of dynamic brain patterns that have causal control potential. Consciousness must be defined as the synthesis of inquiry and not as the outcome of causal processes in the natural world. Without the use of intentional language and a topological analysis of the origin and type of events and actions in the surrounding world it is not possible to speak of consciousness.

The topological analyses in the present experiment concern natural text that was produced by groups of students of Business Administration and Civil Engineering as well as professional economists as their response to the projection of a growth society. A comparison of the respective topological structure with the criteria stated in the article indicates a group difference in progression. It implies a conceptual development in which the resulting state or space phase of the groups is differentially specified. The distinctive aspects characterize the groups such that they can be ordered on a scale from non-consciousness to consciousness. Increasing consciousness implies increasing conceptual autonomy in the respective group's cooperation with its environment, and consequently, also an increase in its chance to survive in competition.

An experiment on topological and algebraic scaling (Bierschenk, 1990) showed identical invariants provided that the units of analysis are logically treated as parts in a system, i.e. like pieces in a puzzle. In the present experiment the units are treated in terms of their relational properties, i.e. it is the relation among the units that define the function of the system. Therefore, the relationship among units of complex systems will not be treated within the classical framework of predicate logic but will be advanced on the basis of Kant's (1724-1804) "Schema" model.

The Schema is Kant's primary concept for giving expression to the functional and structural observer-world dependencies. The observer is an individual of the world. In Kant's sense, both are organized unities which are logically different but in reality not separable from each other. Kant's main argument is that knowing the world should be seen as the outcome of some cooperative act between the knowers' way of organizing information on the basis of cognitive functions and the known, i.e the surrounding world which gives the context to the process of imagination. Kant postulates the Schema as necessary link between such cognitive functions as categories on one hand and "intuition" of information from the world on the other. Thus, the Schema concept has the task to capture the formal and functional conditions of the mind. The Schema functions as a bridge between the individual's intention and orientation. Because of its synthetic nature the Schema produces theoretical concepts, i.e. terms which have a necessary relation to a possible empirical consciousness and which become meaningful only as "parts of a system" (Hartman, 1967). The topological scaling method dealt with here puts its emphasis on the morphogenesis of structure as the result of dynamic processes developing within a language space. It is assumed that the asymmetries and discontinuities in natural language production reflect these processes. Despite great variations and an enormous number of variables, depicting the structure and function of objects and events topologically is feasible as the result of a series of nondeterministic bifurcations within Euclidean space. Their dynamical structure will be given by a vector field (Thom, 1975, pp. 4-17).

Collectivity

The dynamical structure of the world defines the conditions under which the individual can live a personified life. There are different ways of achieving consciousness under changing conditions. Though, living a personified life depends partly on the development of consciousness, partly on what the collective offers by way of "coming to grips with the uncertainties of human existence" (Hilgard, 1986, p. 22). In this respect, the individual discovers a given order which has a certain complexity. Order is embodied in change and complexity is the nature of all natural phenomena.

Culture. The collective is the basis for development of human worth. The way in which an individual becomes aware of itself (Gallup, 1969) depends on what others discriminate (Gallup, Boren, Gagliardi & Wallnau, 1977). It is the turning toward others and the attention of others given to a worthy life that determine the properties of the collective. This has direct implications for the specific features of objectivity and the basic logic underlying choice behaviour. The belief in objectivity implies the assumption that choices and their consequences should be respected. Most of human behaviour is viewed as "a succession of choices made among more or less well-defined alternatives" (Bock and Jones, 1968, p. 1) in social policy-making. Moreover, all the models of choice (rational, social, public or collective) try to formalize the individual member of the collective on the premise of need satisfaction.

Cult. Because it is much easier to pretend one's possession of freedom of choice in decision making situations than achieving consciousness, people may show resistance toward becoming conscious. The ordinary member of the collective obeys might in government that further its opportunities for choice and responds to choices the individual made. Despite knowledge of risk taking the individual is most likely to become a victim of unrealistic expectations promoting a belief in God's will or the will of a supernatural being. The principle of choice entails a particular standard of distributive justice and thus the collective prescription that any choice is a protected choice that must be respected or honoured. The institutionalizing of this "imperative of objectivity" (I. Bierschenk, 1989) implies procedures whose function is to limit consciousness by focusing attention on a

few rationalizing statements or narrowly defined prejudices.

Consciousness

Mental space. Hobbes (1588-1679) was probably the first who stated the syntactic assumption of thinking: It is the mediation of the total sum of parts of an addition. For Leibniz (1646-1716), consciousness is a universe composed of simple immaterial substances. Every substance (= monad) reflects some degree of consciousness. Within Leibniz's universe, space is conceived as the order of coexisting things, while time is defined as the successive states of single monads. The space-time relation of the universe is dependent on the existence of monads. Newton (1642-1727) regards space and time existing independently of physical bodies which exist in space and time. Wallace's (1823-1913) theory of natural selection, as adopted by Darwin (1809-1882), was the ontological step needed in order to study consciousness as a product of natural selection. The hypothesis of a memory whose function is to retain selected bits of information about stimuli, events, images and ideas that have vanished seemed to be the ideal starting-point for the study of consciousness. Brentano (1838-1917) assumed that the variability in the subjective unit of measurement (phi) would be linearly related to the magnitude of consciousness (psi) when measured in the same unit. This linear growth was investigated by Weber (1795-1878), whose law states that it (psi) is a function of the stimulus measure (phi). But Fechner (1801-1887) and Thurstone (1887-1955) put forward a different assumption. Their work is based on the hypothesis that the variability in the psychological unit is constant along the measured continuum (Stevens, 1975, p. 234). This hypothesis constitutes the foundation for psychometrics and was extended to encompass a multidimensional mental space. For example, Guilford (1956) attempted to classify intellectual operations as well as its contents and products within a three-dimensional geometric model. On the basis of this model he predicts 120 facets of mental ability of which less than 40 have been demonstrated factoranalytically. Anderson (1981) believes that the totality of mental processes and acts is accessible by means of an effective cognitive calculation on the basis of a "cognitive algebra", i.e. Leibniz original idea. Thus far, all psychobiological theories define

the "mental space" (psi) as the formal structure of experimental results (Bischof, 1989) in which the agent is an idealized and abstracted individual who cannot view objects directly, because of their indeterminacy.

Language space. A radically different assumption will now be introduced with Kant's Schema hypothesis. (For an extended discussion, see B. Bierschenk, 1981.) The Schema has to be understood as the necessary link between meaning and being. The axiom of a Schema as link in a theory of consciousness is as fundamental as the axiom of number in a theory of physics. This has consequences for the conception of the space-time relation. In Kant's transcendental logic it refers not only to the relation existing between independent substances, but to the relational order that come into existence by a cooperative act. Kant conceives of consciousness as the product of a schematizing process which he calls "Imagination" (Einbildungskraft). Becoming conscious of individuals, acting purposely in a meaningful environment is hardly possible without observing the behavioural expression of an "intended" and "oriented" schematizing of the knowable. Brentano's more important hypothesis states that intentionality is the essential mark of consciousness (Flanagan, 1984, p. 28). This thesis has found little or no attention in modern psychology. The premise of Brentano's act psychology implies that the action-event involvement is the hallmark of all psychological processes. Consequently, the fundamental hypothesis of a language space has to be based on the assumption that language provides the operation space for an active inquiring metaphorical agent, i.e. the textual agent. If a verbal expression cannot be recognized as an intentional act, it cannot serve its purpose of providing meaningful information either. All human development requires an ability of becoming conscious of intentions, movements and the consequences of certain trends. The hypotheses of the present experiment have therefore been formulated as follows:

(1) The structure in the discontinuous sequences of events ties the knower to the known.
(2) The object-event involvement defines the texture in which the structural relations are embedded.

(3) The ability of becoming conscious depends on the knower's awareness of the surrounding world.
(4) Consciousness itself depends on the extent to which invariants can be put into language expressions.
(5) The structure of consciousness is reflected through the asymmetries in language.

Modelling language expressions rests on the basic premise that processes can be isolated and studied with respect to their structural stability and that intentionality and behavioural orientation can be observed. The Agent-action-Objective (AaO) paradigm seems to be general enough to fulfil both requirements. This paradigm constitutes the foundation for the processing of ecological information such that the A's represent intentional behaviour and the O's its orientation. The formal definition of the three basic components of the paradigm has resulted in an algorithmic system comprising about 50 rules (Bierschenk & Bierschenk, 1986). Helmersson (1987) has translated some parts of the system into computer programs. The available program modules are on 3.5 inch disks which are activated within the PC/MS-DOS milieu. The content of the components may be described as follows:

Agent denotes the intentional and thus generic component without which an action can neither occur nor be observed. It is the action centre, i.e. the point from which the action starts.

Action denotes the intentional character of an expression, the agentive. It addresses a physical or mental (loco)motion or rest. Both are absolute and contain information about the agent and not the environment.

Objective denote one or more points of view which contain information about the discontinuous sequences of events, processes and change. The syntactic cues to the viewpoints operate according to the following scheme:

Type of preposition	*Component*
None	Figure
in, on, under	Ground
by, with	Means
for	Setpoint

Figure denotes the physical or abstract existence (Gestalt) of an object toward which the action is directed. It is the absolute point of reference

Ground denotes the point of orientation. It is the absolute axis of reference and marks distance as an extension along the ground. But it may be more or less structurally given in natural discourse.

Means denotes the optional aid or instrument by which an action is performed.

Setpoint denotes the limiting horizon of what can be perceived or conceived.

An analysis of the empirical agents' intentionality and orientation as expressed in natural language requires that the inquiring agent gives verbal expression to its observations by producing unbound text. Under this condition, the language of the observer is assumed to contain both the perspective invariants and the invariants extracted or abstracted from the surrounding world. It is the mark of consciousness that the observer always perceives or conceives the meaning of object-event relationships. It is this cooperative ability through which consciousness can arise.

Experiment

Method

The purpose with the present experiment is to describe a multivariable system as if it had just one or only a few degrees of freedom. The development and establishment of research on conscious processes requires a focusing on the quantifiable aspects of the phenomenon. An indifferent conduct toward scaling or an inability to integrate the measurement process into one's formulation of a theory

leads to serious scientific shortcomings. Suitable threshold models can be selected easily as long as the chosen research approach relies on purely combinatorial models, such as syntactic approaches. Moreover, as long as the data analysis is based upon predicate logic, it is possible to demonstrate that linear and non-linear scales can be constructed that measure one and the same structure (B. Bierschenk, 1990).

A research approach based on transcendental logic, i.e. the AaO paradigm is not only of a qualitatively different kind but presupposes also procedures that are congruent with a synthetic proposition and the development of a nonlinear measurement model. The measurement and representation of language as a dynamic system give expression to the Gestalt notion of consciousness. The graphtheoretical basis of the synthetic model and a corresponding method for text processing has been developed during the 80's (Bierschenk & Bierschenk, 1984-1990). A short description of the method can be found in Dahlgren (1988) and Gabrielsson & Paulsson (1989).

Subjects. Six doctorate students of Business Administration who were instrumental in the 1988 content- and factoranalytic study of some model societies (B. Bierschenk, 1988) constitute the reference group of the present study. For contrasting purposes a group of six doctorate student of Civil Engineering produced under comparable conditions their account of living in a society founded on the growth principle. In the same year, 30 professional economists performed the same task as a warming-up exercise at a one-day seminar on "The Spirit of Enterprise - Culture or Mentality" arranged by "The Foundation for Information and Research on Business Administration and Economics in Lund. For contrasting purposes, six subjects from this group were randomly chosen.

Materials. At the beginning of the 70's it became obvious for many people of the High Technology Societies of the Western World that life quality and one's own worth are intimately interrelated and that both are governed by economic-technological agencies (Roszak, 1986). The most widely known and discussed model, simulating economic and technological growth, is the model developed by Forester and Meadows

both working at the Massachusetts Institute of Technology. Their model is based on the following two assumptions: (1) In relation to population growth, our resources to produce food shelter and energy are restricted. (2) Solely economic and technological knowledge cannot solve the problems posed by restricted resources. But their simulation of catastrophies showed that a covariation of population growth rates with restrictions on resource exploitation could not successfully enough advance our insight into the dynamics of a society based on the growth principle. Extrapolation of known values of economical and technological functions are obviously no feasible way of bringing about behavioural change. What is needed is the requirement of a change in consciousness.

There is every reason to assume that the scientific development to various degree has influenced the modelling of current social systems. Founded on such basic concepts as Cybernetics, Evolution and Behaviour modification the Biological Science Curriculum Study (1976) developed and visualized three models projecting these concepts into future societies as follows: (1) One scenario illustrates how the principle of Behaviour modification is utilized with the aim to design a society. Adaptation and social security are highly valued components of the narrative which develops within this scenario. (2) Another scenario shows a society in which priority is given to both the value of nature and of humans. The narrative operationalizes biological as well as cultural evolution in that evolutionary adaptation, structural change, and the ability to cope with stressors are modelled. (3) The third scenario pictures a society founded on the principle of growth. The narrative develops within the cybernetic context of ongoing population growth and the development of a more and more advanced technology. These narratives have been used in an ecologically oriented research program for the study of mental processes (Bierschenk, 1987; Bierschenk, Helmersson, & Lohmander, 1987; Bierschenk, 1988 a, b, c).

A panel study (Bierschenk, 1987) has shown that the models to a farther or lesser degree can be described by different theories of behavioural science. As expected, the Behaviour modification model is founded on S-R theoretic principles. Surprisingly, its theoretical foundation is not pure. Elements of Gestalt theory are merged with

elements from S-R theory. The reverse is true for the model based on evolution. Some elements from S-R theory make it somewhat diffuse. The model founded on principles of connectivity is the growth model. This model was chosen with the purpose of defining the individual's surrounding world partly because of its theoretical purity, partly because the surface texture was layed out as a modern city of the Western World. A further argument for the selection of the growth model is its correspondence to the assumptions underlying Forester's World Model. The producers describe the scenario of the growth model as follows:

"This section opens with a sunrise over a floating domed city, the symbol of continued growth in both population and technology. The scene shifts to the apartment of the central characters, Joe and Valerie Kane. This projection focuses on a single event - obtaining a permit to camp in a national park. Through the things that happen to Joe, some of the ramifications of continued growth are portrayed. He travels by high-speed magneplane, his attaché case has a built-in public information broadcast system; beggars abound in the city, as does inflation, bureaucratic red tape entangles simple transactions, petty corruption is common-place. The sophisticated transportation system is affected by power outages; poverty, crime, and violence persist; the concept of the use of recreational lands has changed.

This scenario shows some of the possible outcomes of continuing as we are. No value judgment about the 'good-ness or bad-ness' of such a society is being made, nor of the other two social models portrayed in this series. Such valuing is one aspect of viewer involvement. It is important to remember, however, that any social model has both strength and weakness."

Design and procedure. The main thesis of the experiment is based on the premise that consciousness is accessible only in the presence of natural language expressions (LeDoux 1985, p. 206). Kant's hypothesis that language plays the crucial role in human consciousness ensures both the self-referential and the formal function. Brodsky (1987, p. 10) states: "Kant's system of knowledge can therefore be seen to describe a system of narrative - and to describe experience as the narrative - par excellence." The function

of such a system is determined by the mutual dependencies of its constitutive components. Self-referentiality implies that no master interpretation can be forced upon a created text. The basic cues by which the human brain processes the origin and the nature of the object-event relationship expressed are necessarily topological in kind (Cook, 1986, p. 33). The creation and production of natural and thus unbound text as response to the chosen scenario was governed by the following instruction:

"You will be shown a videotaped picture series about a vision of a modern society extrapolating current trends. The purpose is to give you the opportunity to put yourself into this society. You are asked to orientate yourself in such a way that you can derive a pronounced conception of what kind of basic conditions will influence your life in case you would live there. After the display you are asked to give an account of your orientation within the society shown. You may want to utilize some events or character you find worth serious consideration. Please narrate as naturally as possible. Give your narration a forward flow. Circumvent unnecessary corrections."

A requirement for the macroscopic examination of the morphogenesis of the process that produces consciousness, is to unfold its curve by studying locally and globally its singularities. Detecting the structure and dynamics of consciousness requires that physical and social surface features carry ecologically significant information whose content can be verbally expressed as an ongoing process of imagination. Therefore, the audio-visual materials need to afford something for the experimental subject. Furthermore, the materials have to realize purposeful behaviour that can be expressed wordly. The result should be a running text reflecting negative as well as positive affordances of the society. An example of produced text is the following:

"My first reaction to the film is unpleasant. A feeling of discomfort grounded in the situations of enforcement emerging in the film. City milieu, regulations, lack of space, violence, fitting into the system. My basic conditions for making a living in this community is my ability to adapt and my wish to try to live my own life as well as possible. The freedom to undertake anything on one's own responsibility seems to be seriously constraint. What happens if one would like to go outside

the city? I would try to find ways that make it possible to keep my own possibilities of choice. But if I should be successful - I believe I would be bad in advancing on bribes.

To expose myself to situations where violence is included frightens me. I don't feel very well in situations of the type, where the man is knocked down, because of his attack on the automaton; to enter into areas of the type, where the assault took place. Is it possible to influence the community? Is there anything I can do to influence my situation and the community? Are their like-minded which have organized themselves?"

It may be a justified expectation to assume that the judgment of danger is not only quantitatively different but differs even more so qualitatively. This depends not only on who is the judge but far more on what is in the perspective.

Results

The narratives produced by the subjects of a particular group are treated as one text. The results of its analysis are represented in a cubic space (Figs. 1-3) in which the dotted lines of the horizontal planes form the topological surface. The operating structural relations in the background characterize the Figure component. The bottom plane represents the Ground component. The upper half of the left hand side represents the Means component and its lower half shows the Setpoint component. The foreground, the top and the partitioned right hand side depict the text producers perspective. The process depicted within the cubic space enters the terminal states at the edges of the cube. They are determined either by a certain level of significance or a natural shred in the configuration produced by an iterative grouping process of the objectives. The operating structural connections within the topological space deal with the properties of observed discontinuities directly. Thus, the analysis of the produced texts as a dynamic manifold is direct and allows an easy translation of its mathematical properties back into theoretical conclusions.

Doctorate Students of Business Administration

Consciousness or the knowing with others, as it gradually crystallizes through the discourse represented in Figure 1, indicates

Figure 1. Topological Representation of the Consciousness of Doctorate Students of Business Administration

a quite different picture compared to the results based on predicate logic (B. Bierschenk, 1990). Instead of a structure consisting of two invariant components (Eigenvalue and Visibility) the present analysis shows a structure consisting of at least five components. Moreover, the unfolded underlying structure derived on the basis of the synthetic proposition is qualitatively different compared to the structure derived on the basis of the analytical proposition.

The emergent singularities have produced a curve whose highest point is demarcated by the term *Persistency*. It is the indication of an invariable maintenance of ones position despite perceived disorder in the cybernetic system and the urgent problems posed by it. On what the disorder in the growth society depends can be disclosed by the counter-clockwise reading of the processes that have produced the final point of the curve. The processes of both paths leading to *Persistency* end in the singularities *Boldness* and *Repression*. As the longer path shows, searching for solutions to the problems of the society need to be focused not on peripheral or technological issues, but on human behaviour, because it emerges as the core problem. Counteracting *Repression* emerges as a difficult behavioural problem and certainly can only be overcome by socially bold people, i.e. people who are fearless and ready to take risks.

In persuing the term *Repression* further, it is necessary to explore its subcomponents. The bifurcation forms because its representative point lies on the threshold between two domains of attraction, namely one's willingness to face both *Superiority* and *Confrontation*, with the intention to accuse or criticize the functionaries of the system.

Following the path, *Confrontation* must be seen as the negative reaction toward the working of the social control mechanisms. It is the outcome of resentments toward the operating controls. The concern of *Ethics* addresses the necessity of a formalization of the "I"-reference. Of interest is here that personal qualification and the development of participation is something very different compared to an uninformed reliance of confused individuals on either abstract moral principles or constitutional dogma.

Alienation reveals itself as based on two substructures. One concerns the diffusion of personal identity through the requirement of

submission to the collective. The other is rooted in *Cruelty* which is the result of an individualism without personal qualifications.

The intensity or vitality of the action or expression of *Controlling* is the mark of *Authority*. The nature of the relationship of Government and public is captured by two subcomponents. One addresses a *Determination* of protesting, the other the outcome of the prehistoric method of subjectivation cast into modern technology. By that the powerless are transformed into reliable in the sense of amenable subjects. This is always the objective of social domination and thus, the directly perceived provocation.

Powerlessness is the outcome of a transformational process characterized by small changes of the immediate preceding terms. The morphogenesis of this process is determined by an underlying bureaucratic structure aimed at encapsulating and marginalizing the single person. At least two consequences demand attention. Firstly, the transformational steps through the terminal states on the left hand side of the cube form the modern industrial society behaviourally into a society of "primitive" nature. The mysterial processes of transposition and procedural thinking in order to preserve the balance of social processes attract the attention. The terminal states at the bottom of the background reflect the second consequence, namely the awareness of certain limits. The single person is viewed as a marginal case and consequently related to the production of goods and services.

Grounding the Figure

As was stated by the producers, the given scenario exists with a focus on physical and social aspects of a modern society. When that which is given to the observer in the absolute sense has qualities that give the meaning of fear, it can be said that a cooperative relation has come into existence between the observer and the given. The given acts directly upon the observer and this directness gets its value with specification to the observer (Bierschenk & Bierschenk, 1984).

The structural invariant that has been extracted out of its textural embedding shows the reason for fear. The path at the bottom of Figure 1 indicates that the ground of the cybernetic society offers

the danger of an erodation of social structure by a selected, highly educated and powerful group of people.

Perspectivation of Figure and Ground

Perspectivation brings about a new orientation with reference to the focus on the morphogenesis depicted in the foreground and at the top respectively. Through the extraction of a perspective invariant the asymmetrical relation becomes visible. Behaviourally, the perspective may be properly identified with marginalization which is the outcome of a certain kind of thinking, namely procedural thinking through which personal matters of conduct are filtered.

Congruent with the focus on the repression of ethical standards is the perspective invariant extracted out of the ground. The core of the perspective on the ground concerns the balancing of social value.

In summary, the operations required for successful conceiving of one's own acting in the displayed world imply a "mental moving of one's point of observation", that is, an "I"-orientation. Conceiving one's own position relative to the projected world means to orientate oneself toward the highly efficient modern society. The perspective invariants make visible the emergence of a particular category of behaviour in the human mind, namely survival behaviour. The focus is on the danger of conceived social disorder produced by a rigid control mechanism.

Professional Economists

Inference plays an important role not only in scientific analysis but also in the analysis of problems by persons who have specific professional skills and are experienced in their field. By observing transactional events being linked together in the light of specific economic or administrative interests, differences in consciousness may be defined over the contrast between a group of professionals and doctorate students. This division should give an indication of how professionalism influences the perception of the projected world. Moreover, the grouping of subjects this way facilitates the interpretation of the analysis results. As Tryon and Bailey (1970, p. 288) point out, under these circumstances, there would be neither a need for assumptions of causality concerning the quality of the observed

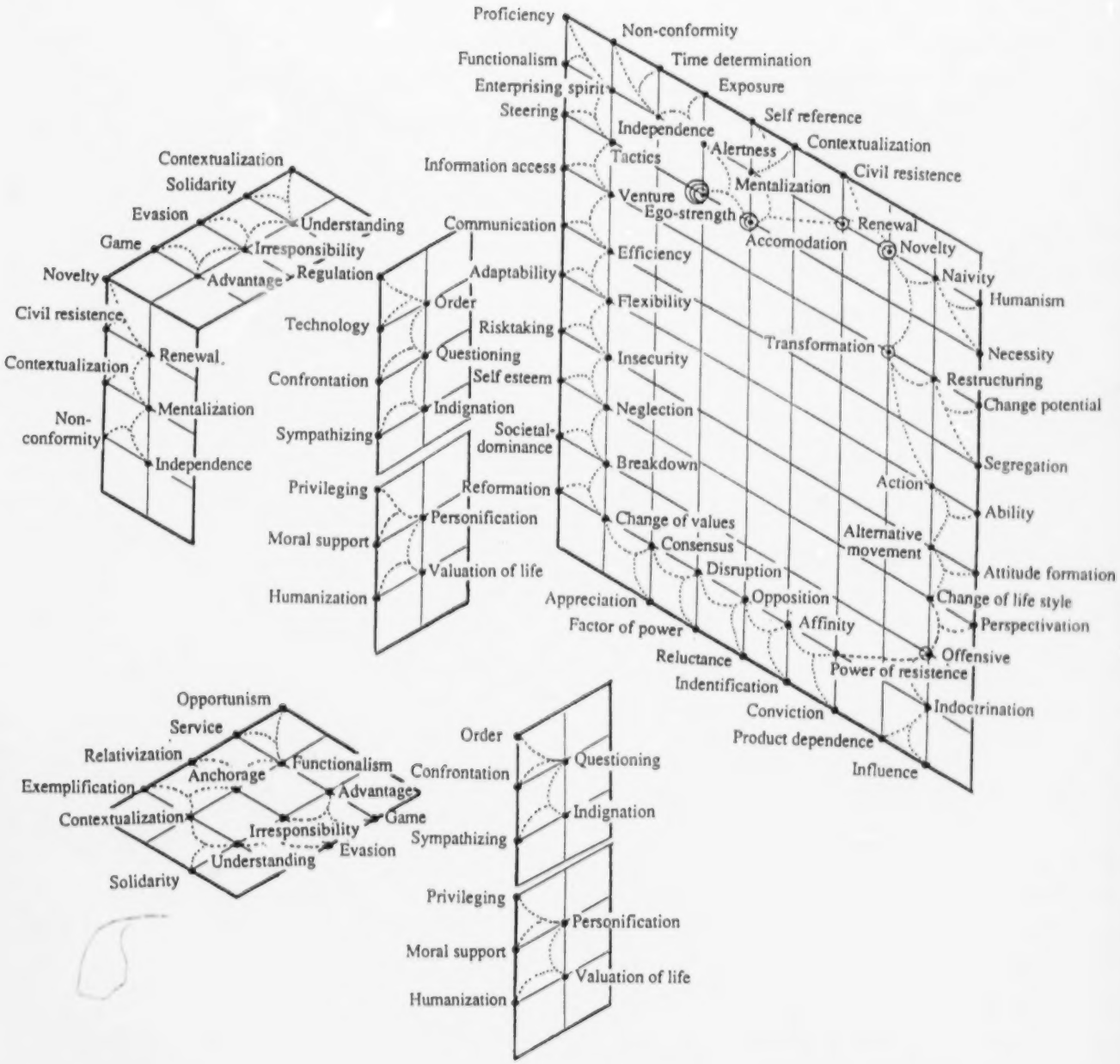

Figure 2. Topological Representation of the Consciousness of Professional Economists

events nor a need for assumptions about normally distributed sample scores.

Figure 2 shows that all conceptual components, namely Figure, Ground, Means and Setpoint are characterized by certain configurations of structural relations. Thus, the process of concentrating the viewpoints of the professionals has led to a richer total configuration. The structure of the Figure component is concerned with *Ego-strength* which is specified by the substructures *Alertness* and *Accommodation*. *Alertness* is the condition of being attentive. It depends on mental power that supports complex information processing but cannot be equated with consciousness (LeDoux, 1985, p. 204). An alert individual is in an optimally wakeful state and is likely to have a high speed of reactivity and a high level of aspiration. *Accommodation* itself emerges out of two subcomponents. The transforming one indicates the necessity of making use of aspects of the surrounding world for required behavioural adjustments. The other subcomponent is rooted in a structure that addresses the judgment of one's ability to come to solutions that make possible *Renewal* of an existing structure by the use of acquired behaviour.

In sum, *Ego-strength* emerges out of a transformational relationship between attentional processes and the ability to adjust one's self-organization. The subcomponents lend little support to the commonly held belief that Ego-strength is an expression of consciousness, conscience or honesty.

Novelty is the outcome of *Transformation* and immediateness. Immediateness appears to be necessary for one's direct perception of what nature has to offer. In this respect, *Novelty* is neither subjective nor objective but exists independently of the particular psychological state of the observer (Reed & Jones, 1982, p. 296).

Transformation itself is rooted in action. Action is the necessary condition for a specification of the nature of change. The underlying theoretical assumption of this substructure is that the perceiver is able to build up transformational invariants as soon as he can conceive himself acting within the displayed world.

By conceiving *Change of life style* and by anticipating *Alternative movement* the inquiring agent detects the information that is needed to guide and control his *Action*. The conceived source for bringing

about action is indicated by *Indoctrination*, i.e. a subtle way of making the person uncritically accepting the doctrine of the system. Confronted with this provocation the reaction is *Offensive*, which is the criterion concept and implies an ability to pay attention to the negative affordance.

The path ending in the singularity *Power of resistance* manifests a negative affordance as defined over the two edges at the left hand side and at the bottom respectively. Metaphorically, the left hand side embodies the attributes of the system which are identified by the pragmatic value orientation, stress on rationality, efficiency, and social dominance. The opposition marks the anticipation of a change toward relational value.

Ground. The specifying component reflects the reason for the position and movement taken. The Ground indicates an evasion of sensed displeasure. The avoidance behaviour strategy manifested in the Ground shows that the rational for survival is taking *Advantage*.

Means. Intimately bound to the "I" acting in the projected world is the *Indignation* which seems to be an aid in extracting the ecological invariant of the negative affordance.

Setpoint. The limits of narrating one's way of living a life in the projected world has also been identified. Beyond the horizon of the displayed scenario life translates into principled moral judgment, rather than into the capability to relate one's action to gambling as rational for survival.

Perspective. The transformations demonstrate the intentional use of significant optical information. The components of the perspective indicate an autonomous inquiring agent who puts his fate into the context of gambling rather than into the context of judgment and reason.

Doctorate Students of Civil Engineering

Dennis Meadows, who is one of the constructors of the simulation model of the limits to world growth, has research interests both in Civil Engineering and in Business Administration. He and his colleagues have made a thorough analysis of many physical and social systems affecting the future world-wide. As a result, Meadows participated in the construction of a the displayed city as a system.

The system is conceived as an associatively connected and interlinked collection of elements that is changing over time. The projected city has been layed out as a simplification of a real city. It is expected that the conditions for long-term growth can be visualized with some precision and that the consequences for survival can be perceived directly.

It therefore becomes important to investigate the question what students of technology perceive when confronted with the visualization of conditions that may determine the future of a modern society. The mental operation required for conceiving oneself acting within the projected city implies that the optic area changes as one moves mentally one's point of observation. The dynamics expressed in the cooperative behaviour implies that an apparent path taken by a particular observer is defined by successive points of observation. Thus, the dynamic conduct creates a flowing texture which is specified everywhere in the rigid surface texture. The flow generates the structural invariants.

Perspective shift in Figure 3 may be viewed as the outcome of the observer's dynamic conduct to the displayed world. The two invariants underlying this singularity are *Reversal* and *Competence*. It is the *Reversal* that transforms *Competence* into the highest point of the curve. The apparent discreteness signaled by the bifurcation may be comprehended as a continuum broken into larger pieces. When the observer is able to identify and adapt to different viewpoints as the result of one's mental moving, *Reversal* reflect no real jump or flip between discrete points of view but only a variation in structure. (Poston & Stewart, 1978).

Kant's hypothesis assumes immediate, not mediate awareness as prerequisite for knowing. The crucial problem is to demonstrate that the world can be perceived when the medium for reflecting its structural qualities is assumed to be conceptual relations made visible in such a way that the conceptual information can be detected and picked up for intentional use. *Self-esteem* is the subcomponent that introduces an observer with an attested sense of mastery. The other component shows that *Competence* is also rooted in the involuntary and sympathetic concern for the other. This makes the person more open and responsive to the concerns of others. *Empathy* itself is

Figure 3. Topological Representation of the Consciousness of Doctorate Students of Civil Engineering

rooted in *Constructivity* whose foundation is defined by two subcomponents. Together, they clarify *Constructivity* as the criterion concept. Though, *Openness* is the perceived "provocation" and consequently tied to the knower.

The path representing the simulated world defines it as *Rationalization*. The characteristic of the displayed society has been identified as a system that is comprised of interdependent parts. Its steering component is addressed at the left hand edge, while the control component shows up at the bottom edge. The contrast inherent in the invariant of this path is reflected at the right hand edge as model of a governor or control system. Behaviourally, its meaning has been discovered as a means for an instantiation of *Perspective shift*.

Ground. Technological reasoning can be identified by the invariant describing the Ground. It originates in an awareness of the threshold conditions of human existence and the explosive nature of current trends inherent in the nature of technological change. It emerges a confidence in the capacity of scientific expertise to control overpowering by expansion in the society. Fascinated by, or possibly immune to the risk taken by continuous growth its consequences have been observed as immaterial.

Perspective. The perspective transformation of the Figure reveals the mental stimulation aroused by the possibility of simulating alternative "Gestalts". Correspondingly, the focus of the perspective on the Ground identifies *Reversal* as virtual shift, i.e. it has the effect but not the appearance of real catastrophies.

Discussion

The design of the present study was layed out as a hypothesis-test procedure with the aim to investigate what the cooperation between conceptualized personal experience and a given physical and social environment means to the development of consciousness. The hypothesis was based on the assumption that the individual is not born with consciousness but has to achieve it during his life time. Consciousness develops partly in correspondence with the individual's ability to narrate an "I" operating within the constraints of its language space, partly in correspondence with the restraints of the external control exercised by some collective. Collectiveness is not

bound to the number of individuals within a group of significant others nor to the number of groups, exercising power within a society. It is a function of the individual's voluntary submission to a belief held by the collective. Ecologically, consciousness emerges out of a con-structive process, were the perspective structure cooperates with the structure of the objective. Thus, whenever observational events structure the language of the observer, this language carries intertwined visual and behavioural information. This information contains the optical, perspective, and behavioural invariants. By making explicit the process of self-reference it is assumed that this process has structured the paths that have emerged as a result of the topological scaling procedure. Moreover, it is assumed that the topology reflects the morphological character of the observers' achieved consciousness.

Achieved consciousness refers to some suitable criteria that permit a judgment on developmental progression. Progress implies that non-consciousness can be identified as the stage succeeded by consciousness. To understand the degree of progression necessitates the stipulation of a goal that can be qualified. In the present context, the goal to proceed toward has been formulated by Meadows. Transformed into testable criteria, it means that the inquiring agent has to become conscious of:

(1) the necessity of simplification in order to understand the real world.
(2) the consequences of growth passing important limits.
(3) the working of control mechanisms in balancing the processes in complex systems.
(4) the probability of a behavioural collapse.
(5) the dependency of social security on the stability of social institutions.

With reference to Meadows' intentions it can be stated that the experimental results give an indication of the progressive development of consciousness. Most progress show the doctorate students of Civil Engineering. Their behaviour exhibits a clear consciousness of the rational of cybernetics underlying the model of a real city. The di-

rective role of consciousness determines the flow underlying the textured surface as imagination of firm confidence in one's competence to adjust the system to the conditions of continuous growth.

The developmental progress in the graph of the doctorate students of Business Administration manifests an adjustment toward an imagined world were moral right and might in government do not fit together. Though, attention is concentrated on justice, which is a shift from the purely believed to the everyday problems of making a living, nevertheless, their graph indicates a preoccupation with an imagined power structure. The conceived social hierarchy provides a means for an articulated repression. The system and its effects are perceived as expression of disrespect.

This kind of adjustment to the perceived world falls within the fifth criterion. Consciousness does not imply a replication or representation. Instead, it has to be understood in Kantian terms as the outcome of man's ability to narrate alternative action and consequences within the language space. The fact that people can be conscious of themselves and their surrounding world provides the basis for justice, law and lawful action. Logically, consciousness and morality may be conceived as a single development. The students have obviously attended to the erodation of moral and ethical principles but concentrated more on the imagined hierarchy of authority and its relation to individual action.

In comparison it seems to be much more difficult for the professionals to adjust to the displayed society. Evidently, they have perceived the contrasting sides of rationality and relational value but do not derive a reasonable degree of consciousness. Typically, they conceive of themselves as autonomous individuals that are forced to examine and adjust their value system. In satisfying their need for individuation and enhancement of self-awareness they take advantage of their relationship to others, take high risks and seek excitement in gambling. In the clashing between rationality and humanistic value the latter is apparently prevailing for the professionals. They stand out as potent self-realizers or self-actualizers resting on top of Maslow's need hierarchy.

The missing link that would turn the professionals from non-conscious or pre-conscious people into conscious persons is in Kantian

terms a dignified existence worthy of moral respect. What is wanting in their graph is an indication of the persistence of consciousness under changing societal conditions which means the capability of self-legislation that would overcome their dependency on Maslow's philosophy of domination.

In conclusion, it can be stated that the classical methods based on the analytical proposition cannot overcome the gap between the meaningless, i.e. and-relations between entities existing independently of the knower and affinity characterizing the organized world within which the knower exists. Kant's solution is embedded in his synthetic proposition. He provided the conceptual tool necessary for analyzing the affinity between the knower and the known. Consciousness as defined by the dynamics of the unfolding curves and their structures determined by the invariants of the curve is the result of broken symmetries, i.e. the establishment or removal of elective affinities in Goethe's sense between agents and objectives. Consequently, the dynamic processes in which text as natural system participates, give rise to an evolving curve which in its totality cannot only be attributed to the produced text, i.e. the text summarized by the analytical concepts defining the terminal states at the edges of the cubic space, but must be attributed to a greater system. This system defines partly the mental space partly the language space. Most specifically, both have played their role in the evolutionary process of creating the Gestalt of the text.

References

Anderson, N. H. (1981). *Foundations of information integration theory.* New York: Academic Press.

Bierschenk, B. (1981). *Conceptions of cognitive functions in a science of knowing* (Didakometry, No. 63). Malmö, Sweden: School of Education, Department of Educational and Psychological Research.

Bierschenk, B. (1987). *Perception of quality of life* (Kognitionsvetenskaplig forskning, No 16). Lund, Sweden: Lund

University, Department of Psychology. (ERIC Document Reproduction Service No. ED 282 892, TM 870 265)

Bierschenk, B. (1988 a) *The visual cliff transformed. A factoranalytic definition* (Kognitionsvetenskaplig forskning, No 25). Lund, Sweden: Lund University, Department of Psychology. (ERIC Document Reproduction Service No. TM 013 836)

Bierschenk, B. (1988 b). *The spirit of human enterprise. A multivariate approach to a study of projected social organizations* (Kognitionsvetenskaplig forskning, No 26). Lund, Sweden: Lund University, Department of Psychology.

Bierschenk, B. (1988 c) A theoretical basis for estimating quality of life. *European Journal of Political Economy*, *4*, 323-332.

Bierschenk, B. (1990). *Behavioural semantics. A comparison between topological and algebraic scaling in the measurement of human dignity* (Kognitionsvetenskaplig forskning, No. 33). Lund, Sweden: Lund University, Department of Psychology. (ERIC Document Reproduction Service No. TM 014 795)

Bierschenk, B., & Bierschenk, I. (1984). *Reasons for cooperative structure* (Kognitionsvetenskaplig forskning, No 7). Lund, Sweden: Lund University, Department of Psychology.

Bierschenk, B., & Bierschenk, I. (1986). *Concept formulation. Part II. Measurement of formulation processes* (Kognitionsvetenskaplig forskning, No. 33). Lund, Sweden: Lund University, Department of Psychology. (ERIC Document Reproduction Service No. ED 275 159, TM 011 260)

Bierschenk, B., Helmersson, H., & Lohmander, B. (1987). *Worthiness as behaviour component* (Kognitionsvetenskaplig forskning, No 17). Lund, Sweden: Lund University, Department of Psychology.

Bierschenk, I. (1989). *Language as carrier of consciousness* (Kognitionsvetenskaplig forskning, No. 30). Lund, Sweden: Lund University, Department of Psychology.

Biological Sciences Curriculum Study, & Crystal Productions (1976). *The program guide to projections for the future.* Boulder, CO: Biological Sciences Curriculum.

Bischof, N. (1989). Emotionale Verwirrung oder: Von den Schwierigkeiten im Umgang mit der Biologie. *Psychologische Rundschau, 40,* 188-205.

Bock, D. R., & Jones, L. V. (1968). *The measurement and prediction of judgment and choice.* San Fransisco: Holden-Day.

Brodsky, C. (1987). *The imposition of form. Studies in narrative representation and knowledge.* Princeton, NJ: Princeton University Press.

Cook, N. D. (1986). *The brain code. Mechanisms of information transfer and the role of the corpus callossum.* London: Methuen.

Dahlgren, C. (1988). *En diskurs om den perspektiviska textanalysen (A discourse in perspective text analysis)* (Kognitionsvetenskaplig forskning, No 23). Lund, Sweden: Lund University, Department of Psychology.

Flanagan, O. J. Jr. (1984). *The science of mind.* Cambridge, MA: The MIT Press.

Gabrielsson, Å, & Paulsson, M. (1989). *Actors general conceptions and strategies for local development. An application of perspective text analysis* (Kognitionsvetenskaplig forskning, No. 28). Lund, Sweden: Lund University, Department of Psychology.

Gallup, G. G. Jr. (1970). Chimpanzees: Self-recognition. *Science, 167,* 86-87.

Gallup, G. G. Jr., Boren, J. L., Gagliardi, G. J., & Wallnau, L. B. (1977). A mirror for the mind of man, or will the chimpanzee create an identity crisis for homo sapiens. *Journal of Human Evolution, 6*, 303-313.

Guilford, J. P. (1956). Structure of intellect. *Psychological Bulletin, 53*, 267-293.

Hartman, R. S. (1967). *The structure of value: Foundations of scientific axiology*. Carbondale and Edwardsville: Southern University Press.

Helmersson, H. (1987). Texteditering och klusteranalys vid perspektivisk textanalys. Version 1.1 (Editing of text and cluster analysis in perspective text analysis. Version 1.1) Unpublished manuscript.

Hilgard, E. R. (1986). *Divided consciousness. Multiple controls in human thought and action*. New York: Wiley.

LeDoux, J. E. (1985). Brain, mind and language. In D. Oakley (Ed.), *Brain and mind* (pp. 197-216). London: Methuen.

Reed, E., & Jones, R. (1982). *Reasons for realism. Selected essays of James J. Gibson*. Hillsdale, NJ: Erlbaum.

Roszack, T. (1986). *The cult of information. The folklore of computers and the true art of thinking*. New York: Pantheon Books.

Stevens, G. (Ed.) (1975). *Psychophysics. Introduction to its perceptual, neural and social prospects by S.S. Stevens*. New York: Wiley.

Thom, R. (1975). *Structural stability and morphogenesis: An outline of a general theory of models*. Reading: Benjamin.

Tryon, R. C., & Bailey, D. E. (1970). *Cluster analysis*. New York: McGraw-Hill.

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